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THE SHELTERBELT PROGRAM IN ALBERTA

A HANDBOOK FOR FIELD STAFF

Alberta
AGRICULTURE
PLANT INDUSTRY DIVISION

D.D.N. 55 94170

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Revised Edition February, 1985

(Original Publication January, 1974)

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THE SHELTERBELT PROGRAM IN ALBERTA

INTRODUCTION

Propagation and distribution of trees for shelterbelt planting has been an activity for Alberta Agriculture since 1952.

One of the first policy statements, outlining the availability and distribution procedure of shelterbelt trees, reads as follows:

> As a matter of policy, the Department of Agriculture has undertaken to encourage tree planting for farm shelterbelts, windbreaks, roadside protection and beautification. District Agriculturists in each area should survey farms within their district for the purpose of deciding where new plantings might be established and where existing shelterbelts could be improved. This policy should be considered an important activity of each District Agriculturist from the standpoint of soil conservation, beautification and roadside protection.

At the time the above outline was written, the supply of Alberta grown trees was limited, the interest from farmers wanting to plant trees was small, and facilities such as planting machines were not available.

The Provincial Shelterbelt Program has made considerable progress since its start in 1950. Its objective can be stated as follows:

Objective

The increasing rate of forest cover removal to provide land for agriculture use, as well as the absence of trees in the southeastern part of the province, exposes large areas to the elements of nature. The tree planting policy is a governmental program which intends to decrease the detrimental influence of the climate on farm fields, as well as around residential areas, while at the same time, it increases the aesthetic value of the landscape.

Parties involved

The various parties involved, with their specific responsibilities for the program are:

- The Alberta Tree Nursery and Horticulture Centre - Location where the planting material is propagated and from which it is distributed.
- Alberta Agriculture, district offices - Location where application for planting stock is completed and where landowners can receive advice on planting and maintenance.
- Agricultural fieldmen's offices - Location where assistance is available for handling the trees at time of planting.
- Recipient of planting stock - Landowners receiving trees for shelterbelt establishment.

POLICY FOR DISTRIBUTION OF SEEDLINGS FROM THE ALBERTA TREE NURSERY & HORTICULTURE CENTRE

With the progress of time, the policy for distribution of seedlings has changed to suit the particular needs of landowners. The following policy now governs the program:

Farm shelterbelt program

Trees will be supplied to farmers, at a small fee, for:

- Farmstead shelterbelts
- Field windbreaks
- Roadside hedges

Farmers will be defined as those individuals who are primary producers of crops and livestock. This definition, as used for tax purposes by the municipality in which the land is located, will be used to determine the acceptability of any particular applicant.

All trees propagated at the nurseries for establishing shelterbelts will be supplied on a first come, first served basis. A properly completed application form must be submitted through the District Agriculturist office. The farmer agrees to the following:

- Payment of shipping charges.
- To use the trees only for shelterbelt purposes as specified above.
- Summerfallow the planting site and maintain the plantation at all times in a well cultivated condition.
- Allow inspection of the planting site.
- It is further understood and agreed that any trees supplied under this policy will not be sold at a later date.

Publicly owned grounds

(Such as school grounds, public parks, playgrounds, hospitals, cemeteries, demonstration arboretums, etc.)

The main condition for granting trees in this group is the

public ownership of the land, an organization which will assure the care and maintenance of the plantation, and submission of a map demonstrating the intended tree planting layout. Only shelterbelt trees and shrubs of standard size and age will be available.

Application for trees should be made by a member of the board of administration of the grounds concerned. Application can be made through the District Agriculturist offices or directly to the Alberta Tree Nursery and Horticulture Centre. All trees and shrubs available through the shelterbelt program will be available for these plantings. Allotment of trees will not, for this type of planting, be necessarily on a priority rating.

The recipient agrees to the same conditions as in the farm shelterbelt program.

Arbor day trees

These are trees mainly for Grade One school children. Evergreen seedlings will be provided, free of charge, to any school board or division that has the facilities to prepare the trees for individual distribution. Application can be made through the District Agriculturist office or directly to the Alberta Tree Nursery and Horticulture Centre.

Limitations

No trees will be supplied from the Alberta Tree Nursery and Horticulture Centre to:

- Anyone for whom an application form has not been processed.
- Those not defined as farmers under the municipal definition of farmers or farming units.
- Christmas tree growers.
- Private and unassociated groups.

Responsibilities

Alberta Tree Nursery and Horticulture Centre

The Alberta Tree Nursery and Horticulture Centre is responsible for the central administration of the shelterbelt program.

General information pertaining to shelterbelt design, layout, maintenance, tree diseases and insects, etc., will be made available to people involved in the tree distribution program. If required, meetings will be held to promote the planting of shelterbelts, while public facilities of press, radio and television will be used to support the program.

The district agriculturist's offices will be informed regarding availability of trees and shrubs by June 1st of each year. This planting stock will be distributed to the users of the program during April-May of the following year, depending on available supply. The final date of accepting tree applications is November 1st. Planting stock will be allotted on a first come, first served basis with the understanding that limits on orders will apply, depending on availability of the planting stock. Approved orders, which cannot be filled due to insufficient supply, will be placed on back order. These orders will be given first priority during the following distribution year, provided the user of the program has indicated that he/she still requires the planting stock.

The following list is the number of trees and shrubs, by species, to be propagated yearly at the Alberta Tree Nursery and Horticulture Centre.

VARIETY	PRODUCTION AIM
Tall Deciduous	
Poplar	600,000
Griffin Poplar	60,000
Cottonwood	30,000
Large Willow	425,000
Golden Willow	35,000
Manitoba Maple	150,000
Green Ash	150,000
Bur Oak	85,000
Small Deciduous	
Small Trees for Normal Soils	150,000
Small Trees for Heavy Soils	50,000
Large Shrubs	35,000
Hedge Plants	
Caragana	1,500,000
Lilacs 450,000	
Honeysuckle	250,000
Roses 110,000	
Small Shrubs for Dry/Heavy Soils	55,000
Dogwood	50,000
Coniferous	
Spruce	750,000
Pine	120,000
Siberian Larch	30,000
(Conservation Bundle	2,000)
TOTALS	5,110,000

The computer services branch

This branch assumes the responsibility for compiling and summarizing the data records of the tree application forms. After the completion of the period for entering applications for planting stock (which runs yearly from June until November), the available stock will be allottedThe following list is the number of trees and shrubs, by species, to be propagated yearly at the Alberta Tree Nursery and Horticulture Centre. by computer. Summaries of the distribution records by districts and regions will be supplied.

District agriculturist offices, field services sector

District agriculturists' offices will accept applications for shelterbelt trees, as outlined in the policy. District agriculturists should have a basic knowledge of the principles involved in planning a farmstead, field, or roadside shelterbelt. They should be able to assist an interested party in planning and designing such a planting. Applications for trees must be filed with the district agriculturist's office to ensure that the requested information, such as land description, ownership and number of requested trees, is valid and true.

Inspection of the planting site is the responsibility of the district agriculturist and/or agricultural fieldman. An effort should be made to inspect as many planting sites as possible. The district agriculturist should act in an advisory capacity to local governments in advising on communal planting projects, the merit of the use of mechanical tree planters, and promote the establishment of shelterbelts.

The district agriculturist's office will verify all applications for shelterbelt trees and forward the completed tree application forms to the shelterbelt specialist at the Alberta Tree Nursery and Horticulture Centre. The district agriculturist will be informed regarding the approval of the applications.

The district agriculturist will maintain close liaison with the Agricultural Service Board (agricultural fieldman) or any similar board of the local government involved in the tree planting program.

Agricultural service boards

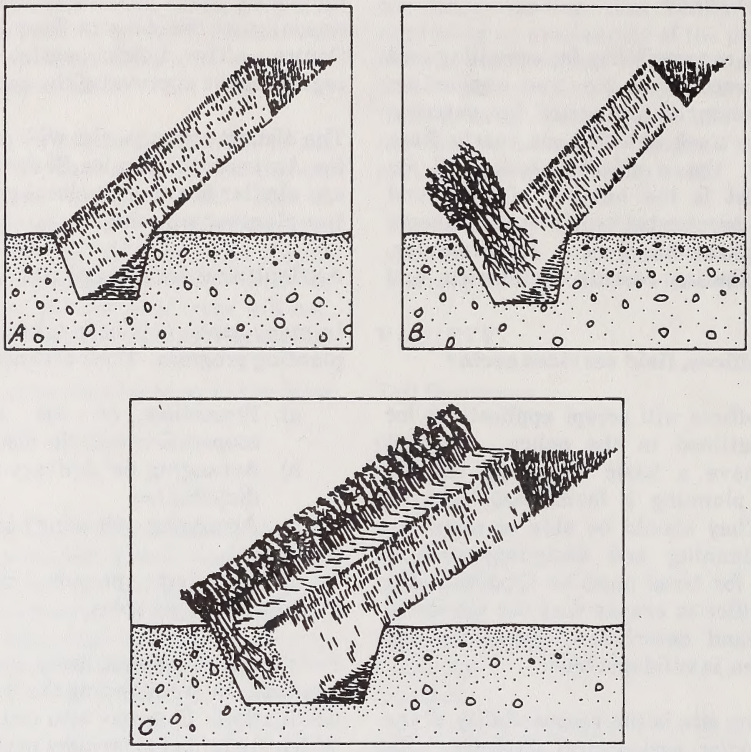
In many cases, this body takes an active part in the tree planting program. Their distinct responsibilities are:

a) Promotion of the shelterbelt program in cooperation with the district agriculturist.
b) Arranging for delivery of the trees for municipal distribution.
c) Arranging planting programs with municipal equipment.
d) Assuring proper care, maintenance and distribution of the trees.

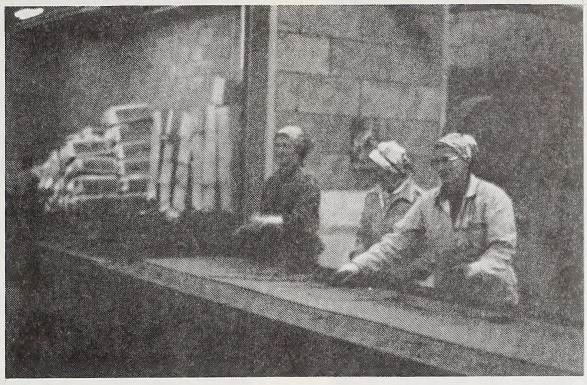
For the above reasons, many counties have made facilities available for transporting the trees from the centre to their destination. Counties also own mechanical tree planters which are rented to farmers to plant their shelterbelt trees.

The recipient

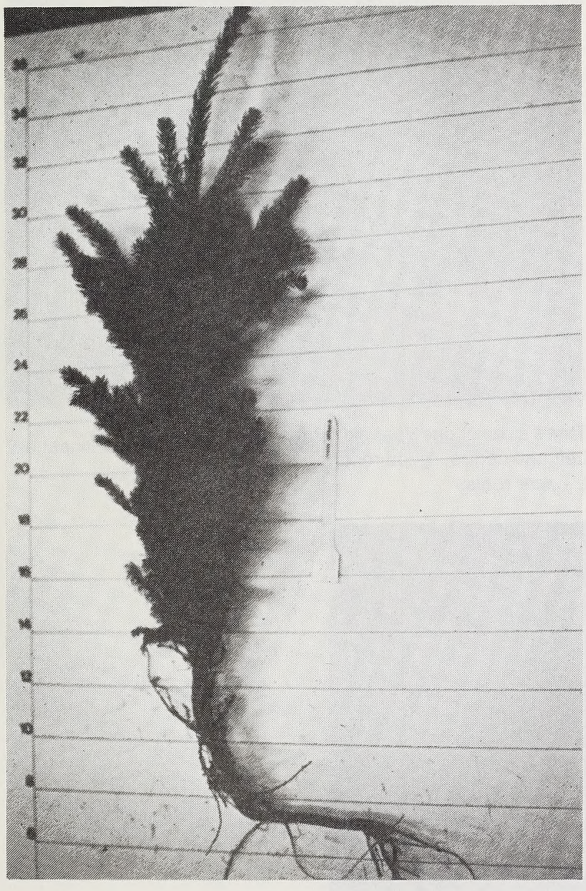
It is the responsibility of the farmer, or any other recipient, to ensure the trees become established. Weed control for the first few years after planting, fencing against livestockand fire prevention are the main points which should receive attention.



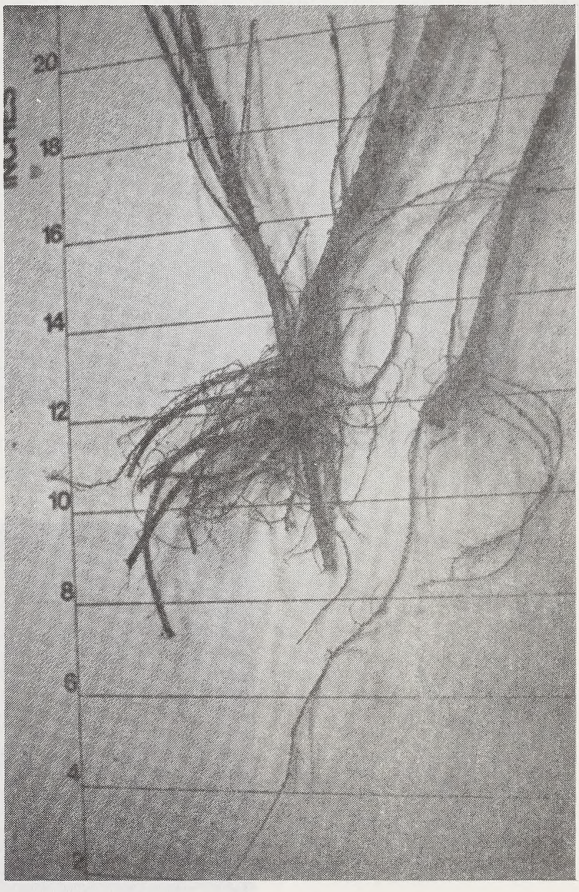
Method of trenching and heeling-in nursery stock if it cannot be planted at once. *A*, Trench is dug deep enough to accommodate roots; *B*, layer of trees is laid against slanting wall; and *C*, soil is piled and packed against tree roots, leaving trench ready for another layer of trees to be heeled-in in the same way.



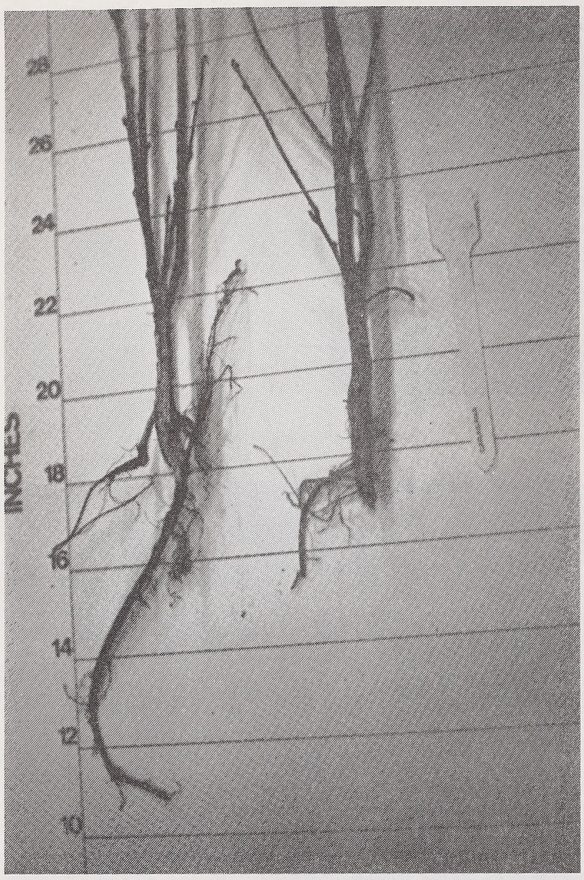
Grading planting stock.



Poor root system of a 3-4 white spruce transplant. The sharp bend of the main root, called a "hockey stick" is the result of previous transplanting.



Defective 2-0 caragana seedlings.
L - split plant base
R - tap root torn off.



Defective 2-0 caragana seedlings.
L - split base
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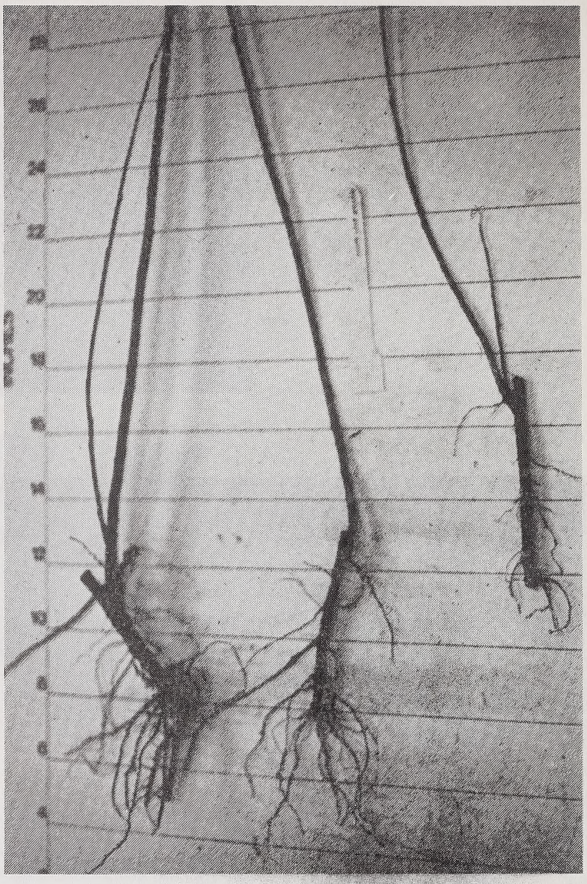
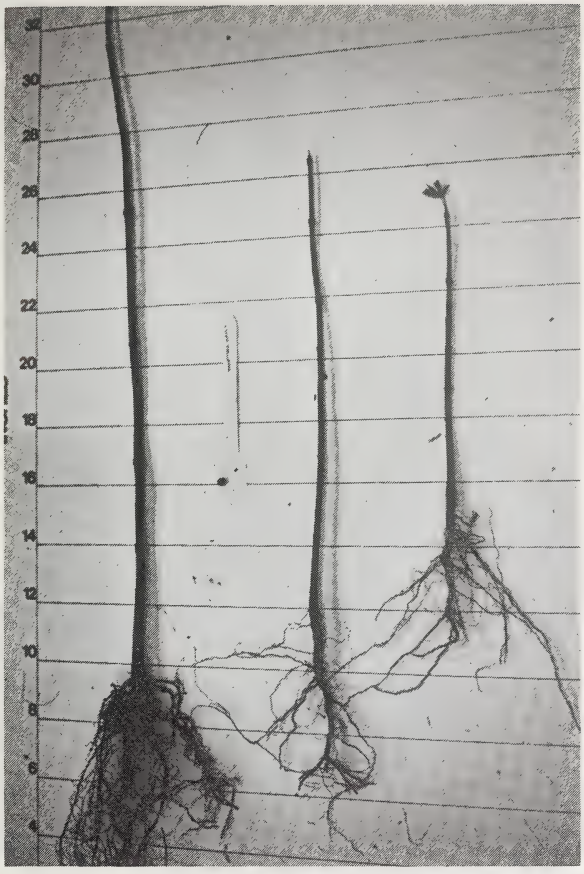
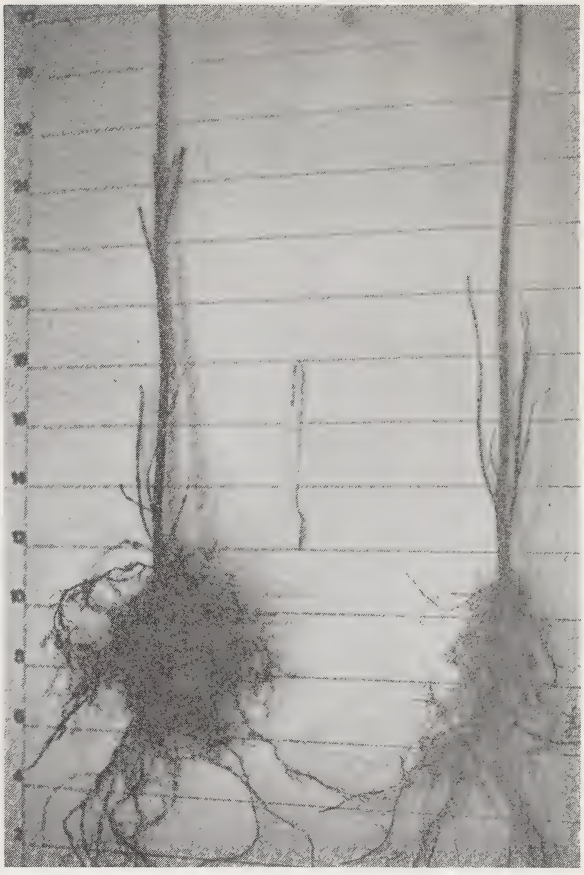


Three sizes of one year old rooted willow cuttings.
Left and centre - good roots
L - poor roots.

Wrapping plant material - peat moss.

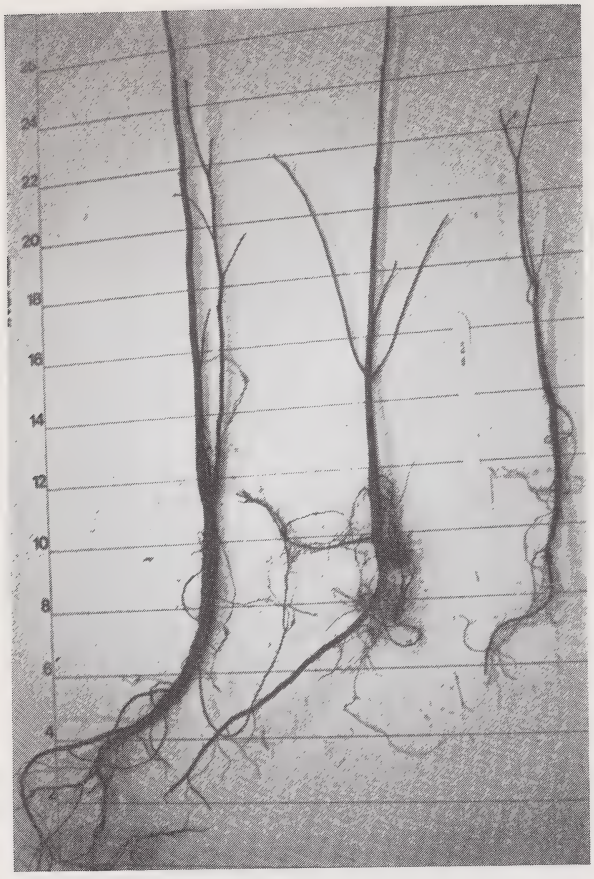


2-0 Manitoba maple seedlings with good root systems.

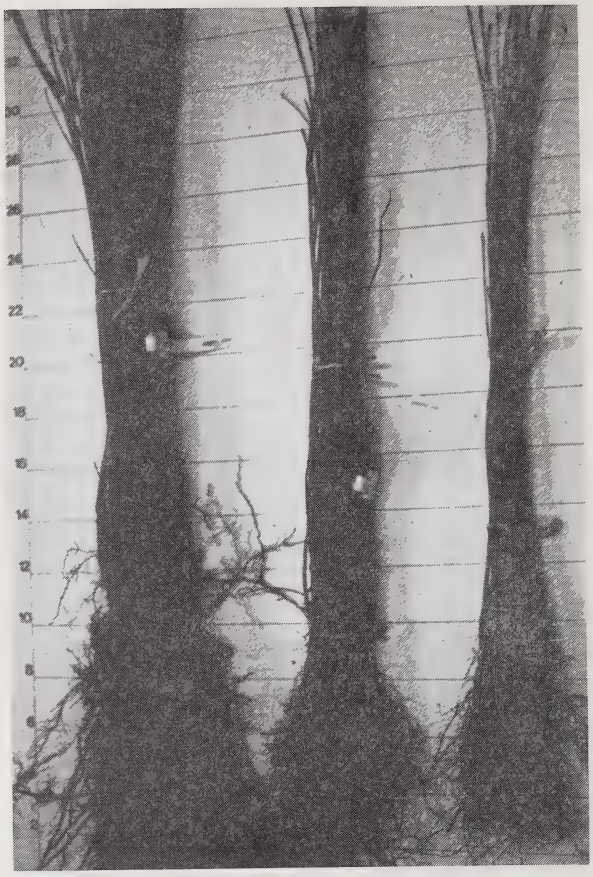


Two grades of 2-0 villosa lilac with well developed root systems.

Rolling the bundle of trees in burlap.



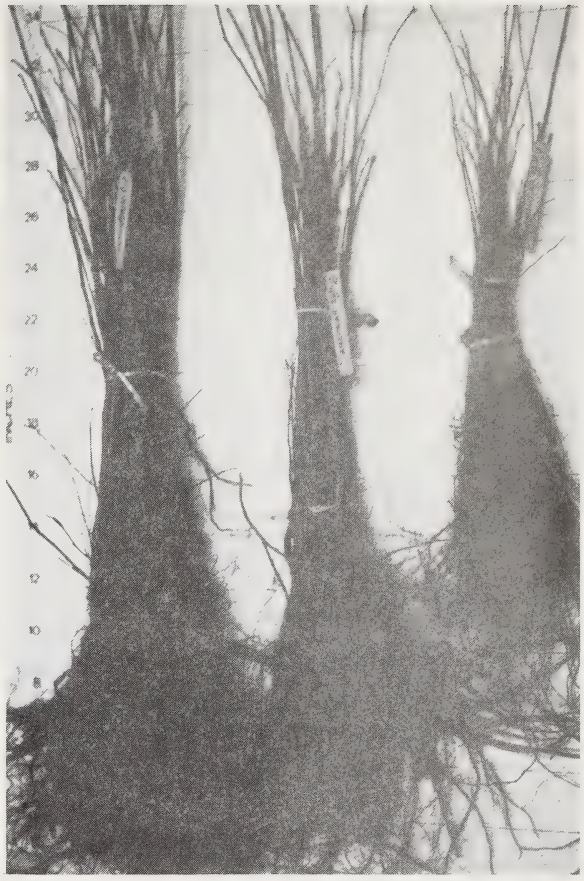
2-0 American elm showing three grades of root systems. L-R 1st grade, 2nd grade and cull.



Three sizes of 2-0 green ash seedlings in bundles of 25 plants.

Topping and pollarding poplar trees.

Three sizes of Tartarian honeysuckle in bundles of 25 plants.



Three grades of 2-0 American elm in bundles of 25 plants.

Releasing spruce by removing a row of deciduous trees.

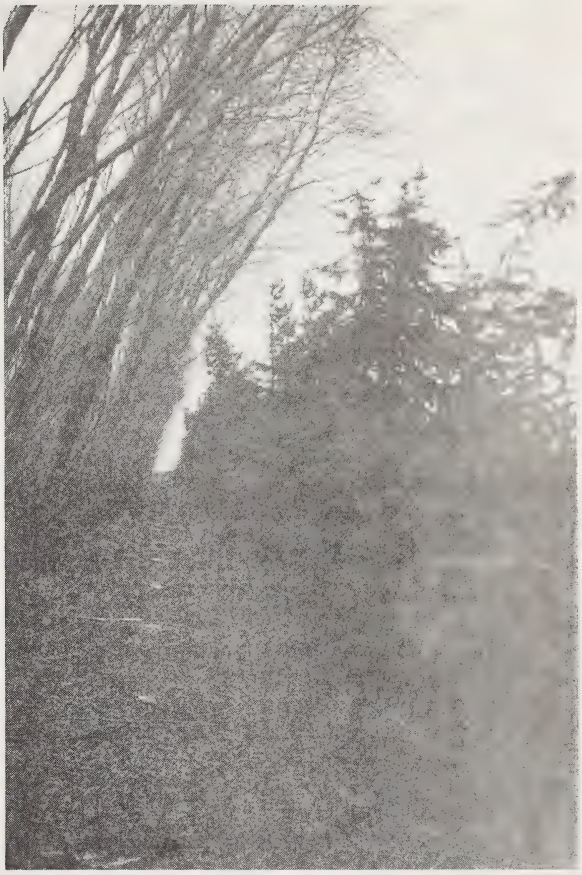
Row thinning in a 25-year old shelterbelt.

One entire row of trees has been removed to reduce crowding.

Two rows of trees have been removed in this shelterbelt.

Topping and pollarding poplar trees.

3-3 White spruce, 10 to a bundle.



Releasing spruce by removing a row of deciduous trees from the shelterbelt.

Grazing damage to shelterbelt.

Planting stock

Quality of planting stock

Survival of newly planted shelterbelts is dependent on the quality of the planting stock, the care given to the planting itself, and the environmental conditions of the planting site (such as weather and soil quality). The nursery is responsible for producing a viable plant of high quality.

Quality of planting stock can be determined by the size and type of the root system and the ratio between root development. A good seedling displays a well defined vigorous root development, is compact and without long spreading runners. Long spreading branch roots should be pruned back. At time of lifting of the planting stock, damage to the root system is unavoidable. The older the plant is at time of lifting, the greater will be the damage.

Certain varieties have, as growth characteristics, the development of a compact, dense and fibrous root system e.g. the lilacs. Others develop a pronounced tap root, which is usually lost at time of lifting. Green ash and bur oak are good examples. The pines tend to develop a wide spreading root system. During lifting, many of the actively growing root and root tips are lost. For such varieties, root pruning at the nursery is required in order to stimulate and develop lateral root formation, which will produce better balanced seedlings and more viable transplants.

Root shoot ratios (i.e., the dry weight of washed roots divided by the dry weight of the stem, or R/S) of 3:1 to 2:1 are desirable while R/S = 1:2 becomes undesirable. R/S ratios of older seedlings tend to drop while evergreen transplants of pine and spruce have a lower R/S ratio because the foliage (needles) are part of the shoot weight. Deciduous 2-0 seedlings with R/S ratios of less than half should be culled out.

Planting stock should be dormant when shipped from the nursery. Since the task of preparing three to four million seedlings for shipping to approximately 10,000 recipients is time consuming, some years the planting stock will break bud and growth becomes evident. Considerable damage to the new growth will occur during shipping the baled planting stock.

Mold development on the root system is often an undesirable occurrence with planting stock in transit. Exposure to higher temperatures (over 10°C) will quickly promote fungus growth on the root system. Therefore, the closer the temperature can be kept to the freezing point the better the quality of the stock. At the nursery, the roots of plants showing signs of mold are routinely dipped in a fungicidal bath. It should be understood that mold on roots does not mean you have a dead plant.

Although mold might indicate root deterioration, it has often been proven that such plants are still viable and should not be discarded.

Age and size of planting stock

The most desirable size of planting stock is a compromise of several factors:

- Convenience and economics of growing the stock at the nursery
- Desirability of size with regard to shipping
- Desirable size at the time of planting.

The longer plant material is grown at the nursery, the larger the size of the planting stock. The following listing of age and size of planting stock is the aim for seedling production of the shelterbelt program at the Alberta Tree Nursery:

SPECIES	AGE OF PLANT MATERIAL	HEIGHT (CM)
1 yr old rooted		
Poplar and willow	cutting	50 - 100
Manitoba maple	2 - 0	50 -75
Green ash	2 - 0	40 -60
Bur oak	2 - 0	30
Mayday & chokecherry	2 - 0	40 -60
Caragana	2 - 0	60
Lilac	2 - 0	30
Dogwood	2 - 0	60
Honeysuckle	2 - 0	60
Rose	2 - 0	60
Silver buffaloberry	2 - 0	30
Spruce	1c- 3	40
Pine	1c- 2	40
Larch	1c- 0	45

The above listed plant sizes refer to unpruned plants. It is standard practice at the Alberta Tree Nursery and Horticulture Centre to trim deciduous shelterbelt stock back to 45 cm of top growth.

Note: In identifying the age of nursery stock, the first number indicates the number of years the plants grew in a seedbed; the second number records the number of years the plant grew after transplanting.

e.g. 2 - 0 is a 2 year old seedling which was not transplanted.
2 - 1 is a 3 year old plant which grew 2 years in the seedbed
and 1 year as a transplant.

c = Container grown

At the Alberta Tree Nursery and Horticulture Centre, the hardwood cuttings of poplars and willows are planted during the first two weeks of June. The rooted cuttings are harvested in the fall. Other deciduous planting stock is seeded during the first week of October. This plant material is harvested in the fall two years later; coniferous seedlings are container grown for one winter season in greenhouses and then transplanted during August-September in the field. Spruce takes 3 years to mature as a 50 cm transplant, while pine is ready for shipping after two years. All coniferous stock is lifted (harvested) from the field in the spring, just prior to shipping.

Identification of planting stock

Since planting stock is always distributed while in its dormant stage, and since the bundles of trees are not always identified with a name tag, it is useful to be able to recognize the varieties, using only winter identification characteristics such as bark color and buds. The key in Table 1 will be helpful for winter identification.

Wrapping of planting stock

Various forms of wrapping material are used for bundling tree orders. Burlap, waterproofed paper, and polyethylene are the most common. In addition to the wrapping material itself, a water absorbing mulch is packed around the roots to keep them moist. The wrapping material used at the Alberta Tree Nursery is:

- Peat moss, for embedding the roots in a moisture containing medium.
- Polyethelene film 2 mil as a moisture proof inner wrap.
- Burlap, the sturdy outer wrapping material.

The bundles, weighing around 50 lb and containing 50-300 bare rooted plants, are tied with nylon string with machine tyers.

Shipping

The best time for planting is the spring, immediately after winter breakup. Fall planting is less desirable because soil moisture is usually low at this time and because the plants have little time to establish new roots before freeze-up. However, distribution of taller spruce at the end of August has been practised at the Alberta Tree Nursery. This activity proved to be successful provided the planting stock was well watered after field planting.

Apart from the early fall shipping of spruce, the bulk of the shelterbelt trees are distributed in the spring of the year. Soil moisture conditions are the best at this time of the year throughout the province and the trees are still in a state of dormancy. The start of shipping transplants varies, depending on seasonal conditions, from April 4th as in 1961 and May 3rd as in 1967 and 1981. Normally, it takes three weeks to pack and move all the ordered material. In general, trees are shipped first to the southern part of the province and last to northern locations.

Activity at the nursery is at its peak during the shipping season. It has proven to be successful to combine all orders for one locality in one shipment. The orders for all applicants in a county or municipal district are prepared as individual parcels and the total order is picked up by a truck at the nursery, according to arrangements made with the district. This system also helps the nursery to conduct a speedier shipping program. The seedlings will then arrive at the destination in a healthy state, which pays off in the form of increased survival.

The district agriculturist and/or fieldman is contacted by telephone three to seven days before the shipment of trees is ready at the nursery. Trucks should be equipped with tarps to tie down and protect the load.

When the truckloads of baled trees arrive in a district, the parcels can either be distributed to the individual farms or kept in a central depot. This will depend on local arrangements. In several counties, a system has developed whereby all the larger orders (200 or more trees) are planted with a county tree planter. With this system, trees to be planted with a mechanical planter do not have to be delivered in advance; they arrive on the planting site on the day of planting.

Bales or bundles of trees, prepared in the manner described above, can be kept for several weeks without hurting the plant material **providing the bales are not exposed to temperatures exceeding 8°C to 10°C.**

However, trees and shrubs, like fruit, are perishable. Ideally, they should be planted as soon as received for best survival and growth. If planting must be delayed by adverse weather, soil conditions, or conflicting farm operations, the bales of trees should be stored in a cool and shady location, preferably in a basement at temperatures not above 5°C. For longer periods, the bales should be broken and the plants heeled-in in a trench, covering the roots with moist soil. DO NOT put the plants in water. The most adverse storage condition is to expose trees to heat.

Site preparation and planting

Summerfallowing the planting site

Government regulations require that recipients of shelterbelt trees prepare their planting site by summerfallowing. Elimination of perennial weed growth is the prime objective for insisting applicants comply with this condition to be eligible for shelterbelt trees. Other reasons for insisting on a cultivated planting site are:

Good planning

People will be a lot better prepared for planting the trees and much more attention will be paid to proper spacing distances. The chance of ordering the correct number of trees is much greater.

Summerfallowing

If carried out for a full growing season, this will give a **better moisture reserve.** Since newly planted trees suffer most from lack of moisture, a well prepared planting site will ensure a higher survival rate. At the same time, there is less danger on a clean cultivated site of competition from other vegetation for the available moisture.

Planting

It is much easier to plant trees in cultivated soil than on sites where the vegetation forms a sod or where perennial weed roots are in the planting strip. A well worked soil will greatly improve the planting operation of mechanical planting machines.

The farmer often fails to summerfallow stubble planting sites prior to planting the trees. These sites should be cultivated in the fall, and again in the spring just prior to planting. In some cases, perennial weed control may also be necessary. If the soil moisture reserve is low, tree survival and growth will be dependent on the seasonal rainfall only.

The importance of proper site preparation has been stressed for many years. Following is a quotation from Ross, 1931 (see bibliography).

> SUMMERFALLOW AS PREPARATION REQUIRED BY THE FOREST SERVICE.
>
> Properly worked deep summerfallow is the only preparation that can be absolutely relied upon to give uniformly good results in all seasons on the prairies. In seasons of extreme drought trees planted on stubble, root land or backsetting are often complete failures. In order, therefore, to ensure, as far as possible, the success of the trees sent out by the Forest Service (Department of the Interior), trees will be granted for planting only on land prepared by summerfallowing, unless in very exceptional cases an inspector should report favourably on specially well cultivated garden land or backsetting. Under no conditions will trees be given to plant on spring or fall ploughed stubble.

The method of summerfallowing can be the same as that followed in a crop rotation. Weeds should not be allowed to set seed. On very heavy soils, the depth of cultivation should be increased to such a level that the tree planter can easily perform its job. The depth of planting depends on the size and variety of the transplant. In general, with the mechanical planter, planting depth varies between 10 and 20 cm, depending on the size of plant material. In the spring, before planting, additional discing is recommended where early germinating weeds appear. However, at this time, only the surface should be worked, preferably at least a week before planting. Deep tillage immediately preceding planting is wrong, as it tends to dry out the soil and the roots of the transplants do not become as firmly embedded in the soil.

When a shelterbelt is to be planted on grassland or in an alfalfa field, it will be necessary to plow the strip to be planted. The turned sod should be worked the year preceding planting until it is well decomposed. In areas where irrigation ditches for watering the trees are planned, it is recommended that these ditches be constructed in the fall preceding the planting. On light sandy soils it is important to maintain as much coarse litter as possible to prevent soil erosion. An application of manure with a large amount of straw may be helpful if incorporated a year in advance.

When multiple row shelterbelts are planned, it is not necessary to summerfallow the total area between the rows (spacing between rows often requires distances of 5 m as a minimum). A much narrower strip of 1.5 m is sufficient to be cultivated. The noncultivated strips should be planted to grass, which should be kept mowed.

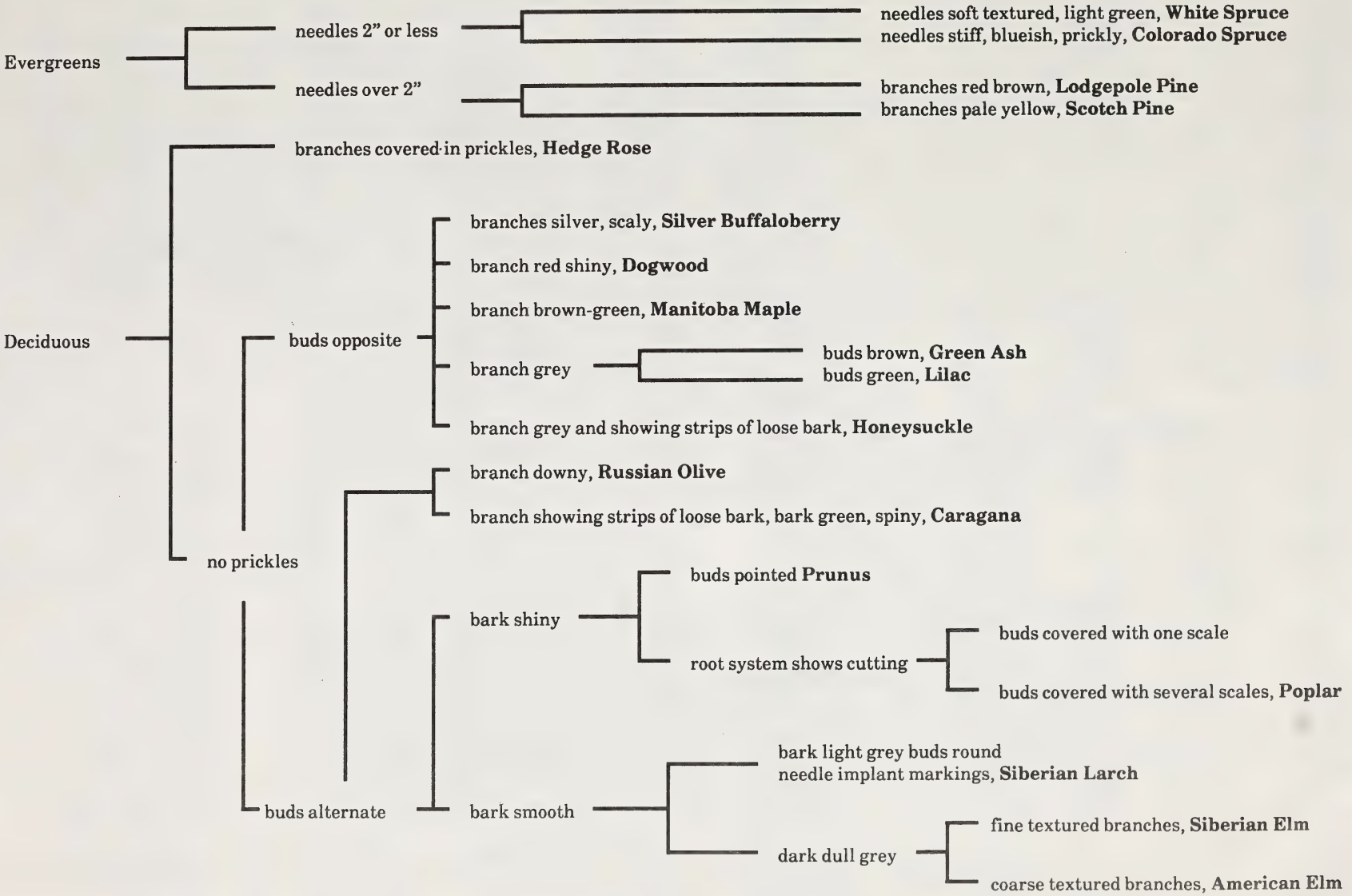
A shelterbelt should be laid out in harmony with the contours of the terrain. Avoid low wet spots or areas where spring flooding is likely to kill the trees. The shelterbelt should be planted in such a manner that low spots are avoided, the shelter is not interrupted and the trees are planted where they will survive. All trees and shrubs can be planted close to the high water mark of sloughs, but very few trees will survive flooding, especially spring flooding.

Site inspection

It was stated at the outset of this manual (see quality of planting stock) that survival of a new plantation "is extremely dependent upon the quality of the plant itself". However, even the best of plants will be no use if the recipient mishandles them.

Planting stock was distributed free to prairie farmers for many years. The farmer was only responsible for the

TABLE 1
Key for Identification of Shelterbelt Species Using Winter Characteristics


Evergreens
needles 2" or less
needles soft textured, light green, White Spruce
needles stiff, blueish, prickly, Colorado Spruce
needles over 2"
branches red brown, Lodgepole Pine
branches pale yellow, Scotch Pine
Deciduous
branches covered in prickles, Hedge Rose
no prickles
buds opposite
branches silver, scaly, Silver Buffaloberry
branch red shiny, Dogwood
branch brown-green, Manitoba Maple
branch grey
buds brown, Green Ash
buds green, Lilac
branch grey and showing strips of loose bark, Honeysuckle
buds alternate
branch downy, Russian Olive
branch showing strips of loose bark, bark green, spiny, Caragana
bark shiny
buds pointed Prunus
root system shows cutting
buds covered with one scale
buds covered with several scales, Poplar
bark smooth
bark light grey buds round
needle implant markings, Siberian Larch
dark dull grey
fine textured branches, Siberian Elm
coarse textured branches, American Elm

delivery cost. With such a free service there was a real danger that the planting stock might become neglected or that farmers would order too much.

Furthermore, users of the shelterbelt program are often uninformed or misinformed about basic design requirements, such as the use of the different species and varieties, spacing recommendations and distribution details.

Therefore, the policy has been changed so that a small application fee will be levied and for larger volumes of plants, a small charge is made.

In addition to a small charge for the service, intended planting sites must be inspected. Ideally, this inspection should be carried out in the fall, prior to the spring planting. The summerfallowed strips of land should be in a clean, well cultivated condition and fenced against livestock in locations where grazing is a common form of land use. The inspector should have the authority to refuse the application for trees. Another common shortcoming of the distribution program is that people are inclined to plant trees too closely together and/or request more trees than they really need. Such a practice develops into poorly planned plantings and a waste of nursery stock. Site inspection, consistently carried out, will eliminate or correct this form of misuse.

With rapidly increasing labor costs, the funding and operation of a large nursery becomes more and more costly. On the average, a single tree order of shelterbelt planting stock contains 400 plants. The average production cost of one seedling plant, except for caragana which is considerably less expensive, is 25¢ (1985). In other words, the average tree order costs a minimum of $100 to grow the plants F.O.B. the nursery. In view of such a price tag, these plants must be handled and cared for in such a way that they reach their objective and are given the proper conditions to develop into a valuable shelterbelt.

Since a large number of people receive trees each year (8000 in 1985) the task of inspecting all sites is by no means small. Alberta Agriculture's extension offices and the offices of agricultural fieldmen are involved in carrying out this work. In many districts, this system is quite effective. Unfortunately, not all field offices appear to have sufficient staff to handle this inspection work.

Planting

Before a planting operation starts, the person in charge of planting should be familiar with the tree species (see Identification of Planting Stock). There should be a plan which explains the intended layout and design of the windbreak. Since one hopes that the trees will occupy the site for many years to come, careful planning cannot be overstressed.

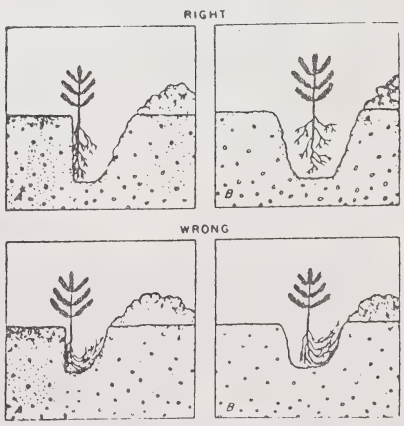
DURING THE PLANTING ITSELF, THE TREE ROOTS SHOULD NEVER BE ALLOWED TO DRY OUT. Even short periods of exposure to sunshine will kill the exposed parts of the roots. The burlap wrappings and the moist peat moss should be used as much as possible to cover up the roots on the baskets of the mechanical planter. In the case of hand planting, the transplants should be carried in a pail with some muddy water.

Here are some general rules which apply to plant nursery stock:

- Plant the trees slightly deeper (never shallower) than the depth that the trees were planted at the nursery.
- Dig the hole large enough to contain the root system without bending or doubling the roots. Extremely large roots should be pruned back.
- Tramp the soil firmly around the roots and do not use infertile subsoil for filling the hole.
- Plant the trees upright.
- Stake out the rows where the trees are to be planted. The row markers should be placed 60 m apart. In multiple-row
- shelterbelts, be careful to get the rows parallel.
- Lay corners out in smooth running curves to facilitate mechanical cultivation. Square corners require turning space and could be used for exits to the fields from the farmyard.

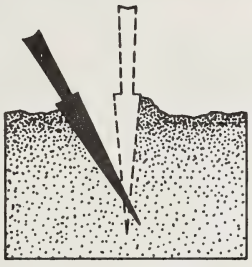
Hand planting This is still being carried out to a large extent. Under average conditions, 400-500 trees can be planted per man-day, depending on the size of the trees, etc. Evergreens need the most care in planting.

In general, the round pointed shovel does the best job. The hole to be dug should be large enough to contain the root. With the side-hole method, the tree is held against one vertical side of the planting hole. In this case one side of the hole is kept vertical. The centre-hole method is similar except that the tree is placed in the centre of the hole.

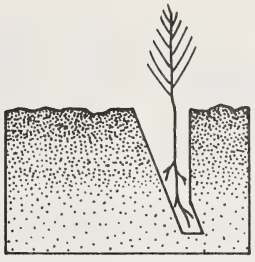


—Right and wrong methods of hole planting: A, side-hole method, and B, center-hole method

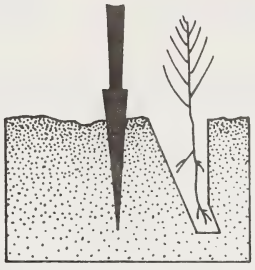
In cases where the planting stock is small, it is practical to plant trees using the "slit method". This method consists of making a slit in the ground, inserting the root system, and closing the slit again with the shovel.



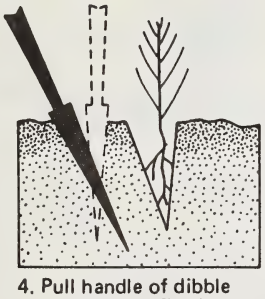
1. Insert dibble at angle shown and push forward to upright position.



2. Remove dibble and place seedling at *correct* depth.

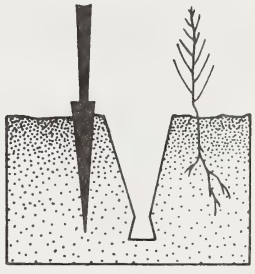


3. Insert dibble 2 inches toward planter from seedling.

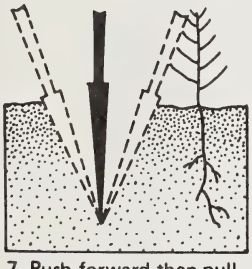


4. Pull handle of dibble toward planter firming soil at bottom of roots.

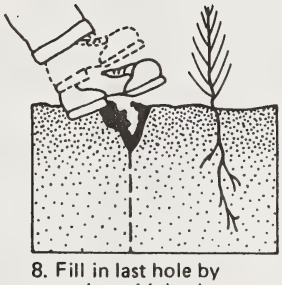
5. Push handle of dibble forward from planter firming soil at top of roots.



6. Insert dibble 2 inches from last hole.



7. Push forward then pull backward filling hole.



8. Fill in last hole by stamping with heel.

9. Firm soil around seedling with feet.

Machine planting Many counties and municipalities have invested in a planting machine. Basically all planting machines, whether purchased from a manufacturer or built locally, are of similar design. Although the usefulness and mechanics of these machines will not be discussed here, some of the shortcomings, resulting from improper use, are outlined below.

Shallow planting All trees must be planted at the same depth as they were growing in the nursery. Adjusting the planting depth to the proper level requires close observation. Planting too deep will kill coniferous trees.

Planting at too great a speed Since machine planting often becomes a routine matter, there is always a danger of lowering the quality of the planting job. The roots of the trees may be doubled up or squeezed into a small ball, two or three of the trees may be planted in a cluster instead of separately, or the trees may not be planted vertically. The recommended spacings are based on the assumption that growing trees occupy each planting spot. Any tree planted wrongly has a very poor chance of survival and failures have to be replaced.

After a row is planted, the planting job is not completed. A machine planted tree needs **aftercare.** The shelterbelt owner should "walk" a planted row, pack the soil around each tree with his feet, straighten up slanting transplants and check for missing plants.

Finally, with machine planting, always remember **"Speed is important but survival is more important".**

A recent new addition to mechanical tree planters is a two nozzle spray-boom and tank placed between the tractor pulling the tree planter and the tree planter itself. This spray boom applies a pre-planting herbicide, Trifluralin, at .90 to 1.80 kg/A.I. (active ingredient) in 250 L of water to a 1 m strip. The herbicide must be incorporated into the top three to 10 cm of soil with a rototiller which is placed immediately in front of the tree planter. Trifluralin will control many annual weeds during the first growing season, but this chemical will not control stinkweed and wild mustard.

Initial care of planting

Plantation survival and replacements

Following is a summary of total tree distribution from the Alberta Tree Nursery and Horticulture Centre, Alberta, over a 15 year period:

DISTRIBUTION

VARIETY	1969	1972	1975	1978	1981	1984
TALL DECIDUOUS						
Russian Poplar	121,300	65,650	35,775	93,025	-	-
Northwest Poplar	950	-	1,950	26,275	21,000	34,980
Brooks #6 Poplar	81,425	19,895	49,150	261,475	57,375	215,000
Griffin Poplar	8,375	21,000	20,475	16,300	15,000	45,000
Plains Cottonwood	-	-	-	5,900	3,000	18,000
Laurel Leaf Willow	92,290	75,230	165,250	41,900	111,000	115,000
Acute Leaf Willow	64,275	47,750	33,500	81,850	104,075	105,000
Golden Leaf Willow	-	9,150	42,800	24,600	22,000	30,000
Peach Leaf Willow	-	2,825	4,800	4,750	5,500	7,000
Manitoba Maple	78,350	102,965	46,865	134,075	126,425	73,000
American Elm	-	22,550	43,350	-	-	-
Manchurian Elm	24,500	30,975	73,225	-	-	-
Green Ash	49,042	61,375	37,500	103,200	84,900	90,375
Bur Oak	-	65	6,325	-	22,150	7,100
White Birch	5,400	-	3,500	10,500	19,000	20,500
SUBTOTAL	525,907	459,430	600,240	803,850	591,425	760,955

DISTRIBUTION

VARIETY	1969	1972	1975	1978	1981	1984
SMALL DECIDUOUS						
Mayday	20,750	9,910	13,600	-	20,000	43,000
Chokecherry	27,820	150	1,275	-	9,800	32,000
Pincherry	-	1,875	-	-	-	-
Russian Olive	-	16,525	-	-	9,000	8,565
Buckthorn	630	3,975	3,175	-	-	-
Sea Buckthorn	-	-	-	-	9,275	4,300
Hawthorn	5,825	13,700	31,775	-	2,200	-
SUBTOTAL	**55,025**	**46,135**	**49,825**	**-**	**50,275**	**87,865**
HEDGE PLANTS						
Caragana	953,940	683,810	576,075	1,298,950	850,000	800,100
Villosa Lilac	39,675	157,080	36,675	90,300	149,075	99,000
Common Lilac	1,750	-	15,525	22,225	165,000	95,000
Honeysuckle	120,375	106,230	105,625	54,875	12,000	146,000
Dogwood	-	31,960	17,475	7,875	39,575	52,000
Hedge Rose	23,675	12,800	-	1,225	14,000	53,000
Altaica Rose	-	-	-	-	11,700	8,800
Silver Buffaloberry	-	2,450	-	1,200	14,575	2,225
Cherry Prinsepia	-	-	-	-	20,000	10,000
SUBTOTAL	**1,139,415**	**1,004,330**	**751,375**	**1,476,650**	**1,275,925**	**1,266,125**
CONIFEROUS						
White Spruce	61,410	75,260	91,900	23,500	183,320	167,000
Colorado Spruce	242,816	195,270	98,900	80,000	84,000	130,000
Norway Spruce	-	-	-	-	-	1,500
Lodgepole Pine	25,000	15,070	23,150	17,000	27,160	38,670
Scotch Pine	-	2,070	-	-	24,000	39,000
Siberian Larch	8,450	13,890	16,450	40,190	10,000	17,850
SUBTOTAL	**337,676**	**301,560**	**230,400**	**160,690**	**328,480**	**394,020**
CONSERVATION BUNDLE	**800**	**1,000**	**990**	**980**	**1,000**	**1,450**
GRAND TOTAL	**2,058,023**	**1,811,455**	**1,597,055**	**2,442,170**	**2,247,105**	**2,510,415**
TOTAL APPLICATIONS	**4,212**	**4,549**	**5,039**	**6,070**	**6,946**	**8,398**

As stated before, the survival rate is greatly dependent on the proper care of newly planted trees and shrubs. Under normal conditions, which means trees are planted in the early spring on summerfallowed sites, it should not be necessary to water the trees. However, in some years the spring season can be unfavorably hot, dry and windy.

Under these conditions, particularly in the more southeastern regions of the province, it is necessary to water the newly planted stock until the plants leaf-out and start to grow. Emergence of new leaves and continued development of new growth is a sure sign that the trees are becoming established.

New plantations are seldom 100 percent successful. Under less then ideal conditions, considerable mortality takes place during the first growing season. With the wider spacing recommendations, these gaps should be filled in the following spring with the same varieties to avoid holes in the windbreak. The sooner these replacements become established, the better. The use of different tree species for replacements is not recommended. Mixing different varieties in the same row is not a good practice because the faster growing variety will eventually suppress the adjacent slower growing one. Different varieties do not have equal growth rates and identical compatability.

Surveys to document and analyze survival rates of newly established shelterbelts, as well as older more mature shelterbelts, were carried out during the past 10 years, as follows:

YEAR OF SURVEY	AREA SURVEYED	NUMBER OF FARMS SURVEYED
1974	Region 4	99
1975	Region 1	134
1976	Region 6	125
1982	Region 5	87

Plants established between 1966 and 1980 were, in all four regions, selected at random. The number of surviving trees were counted and this figure was compared with the original number of trees distributed for each site. The condition of the planted shelterbelt was analyzed and recorded. A typical survey result is exhibited in the following table:

TREE SPECIES PERFORMANCE - ALL THREE YEARS OF PLANTING (REGION 6)

TREE SPECIES	NO. OF SITES	DISTRIBUTED AMOUNT	AMOUNT LIVING	PERCENT SURVIVAL
Northwest Poplar	4	750	179	24%
Russian Poplar	48	10,760	6,010	56%
Brooks #6 Poplar	8	1,625	684	42%
Griffin Poplar	2	350	96	27%
Laurel Leaf Willow	7	1,200	425	35%
Acute Leaf Willow	11	2,775	1,793	65%
Manitoba Maple	44	7,145	4,431	62%
American Elm	2	140	96	69%
Manchurian Elm	5	1,305	373	29%
Green Ash	19	1,735	808	47%
Bur Oak	6	375	46	26%
White Birch	1	50	0	0%
Mayday	15	1,035	287	28%
Chokecherry	8	3,900	101	3%
Caragana	29	18,375	14,009	76%
Villosa Lilac	32	10,535	6,971	66%
Common Lilac	7	1,125	633	56%
Hungarian Lilac	1	800	20	3%
Amur Lilac	1	25	4	16%
Honeysuckle	38	8,470	4,405	52%
Hedge Rose	5	325	175	54%
Red Leaf Rose	4	75	15	20%
Altaica Rose	1	50	0	0%
White Spruce	16	2,885	1,186	42%
Colorado Spruce	40	7,185	3,683	51%
Lodgepole Pine	12	865	256	29%
Scots Pine	17	2,680	770	29%
Siberian Larch	3	150	25	16%
Douglas Fir	3	150	107	71%
Hawthorn	2	75	45	60%
Dogwood	2	55	24	44%
Conservation Bundle	25	25 bdls	17 bdls	68%

Every year and region of survey was summarized. A typical report of the survey results is the following summary (from Region 6 - 1976):

> The shelterbelt survival survey for the Peace River region included 125 plantings established in 1966, 1969, and 1976. Of the total of 86,659 trees and shrubs distributed, 47,487 trees or 55% were living at the time of observation. For several of the species surveyed, the distributed amount was rather small. The survival percentages of all species is greatly dependent on the treatment the trees received. It should be stated that the most deciding factor in the success of the shelterbelt planting is the people who are planting the trees. Without a conscientious effort on the part of the planter to maintain the planting area, the shelterbelt has little chance of success.It was found that 60% of the trees were used for farmstead plantings. The practice of establishing field and roadside shelterbelts in the Peace River is not very widespread. Sixty-eight percent of the distributed trees were hand planted. Of the total of 125 surveyed plantings, 70 were considered to be developing into successful shelterbelts whereby more than half the planted trees were growing at the time of the survey.
>
> **Planning** of the shelterbelt before ordering the trees and shrubs is very important. In a majority of cases the trees are overordered and are either overcrowded in the planting area or not planted at all. The condition of the plant material as received from the nursery was reported as satisfactory. There were only four incidents where the planter was unsatisfied with the condition of the material.
>
> The successful establishment of a shelterbelt is dependent on proper cultural maintenance. In as many as 38% of the sites, there was no evidence of any cultural practices.
>
> Soil moisture in this district is not as critical as in other areas, especially in a year as wet as 1976. The high rainfall received this year enabled some of the newly established plantings to get an excellent start, especially apparent on certain species such as poplar, willow and honeysuckle. The abundant moisture also gave an added advantage to the new plantings to survive even when in competition with other vegetation. In a dry year many of these plantings may not have survived as well because of the competition for necessary moisture.

Weed control

Cultivation before establishing plantations has been stressed before. The message is clearly emphazised in the opening paragraph of the publication "Chemical Weed Control in Shelterbelts" ESAU (1973).

> Controlling weeds is one of the most important factors affecting the successful establishment and growth of new shelterbelts in the Canadian Prairies. Weeds create severe competition for soil moisture and nutrients with which slow-growing trees and shrubs are unable to cope. Approximately 70 to 80 per cent weed control is considered necessary to provide satisfactory conditions for new plants. Since hand weeding is laborious and costly, chemical weed control provides a more practical solution to the problem.

Around newly planted trees and shrubs, weed control can be carried out either through mechanical or chemical means.

Mechanical weed control, carried out with the proper care, is the surest and safest way for providing favorable growing conditions. Strips 1-2 m in width should be kept cultivated on either side of rows of planted trees. In multiple-row shelterbelts, it is desirable to keep the strip between the rows cultivated.

Cultivation should never be deeper than 5-10 cm. Machine cultivation close to the trees themselves should be avoided - hand tools might have to do the job here. While deciduous trees are small (the first two years after planting), the strip between the trees can be cultivated with so called "over-the-row" cultivators. Such a harrow cultivation should be done before the weeds are taller than 15 cm. When the trees become taller than .5 m, the over-the-row cultivation should be stopped. Mechanical cultivation with common farm implements can usually be carried out on shelterbelts for the first 8-12 years if recommended spacings were used in the planting layout. In the earlier years, 3-5 cultivations per season are usually needed for adequate weed control. Since the available space between rows narrows as tree grow bigger, the width of the implement and the size of the tractor usually decide when mechanical cultivation has to be discontinued. When lack of space prevents further cultivation between trees and/or rows, it is recommended that cultivation of the outside fringes be continued. These fringes can move further out from the belt when the tree structure expands.

Chemical weed control in shelterbelts has been researched for years and is well documented in the publication listed in the literature list at the end of the publication.

Herbicides can kill and injure trees when improperly used. A herbicide like paraquat is subject to drift and can damage shelterbelt trees or do damage to neighboring plants. Careless application of chemicals, the use of the wrong formulations, and improperly calibrated spraying equipment can do a lot of harm to shelterbelt trees and to the immediate environment. Cultivating between rows of trees or on the fringes of a shelterbelt is easy with

machinery such as discs and cultivators. The strip of land between the trees in the rows is more difficult to cultivate mechanically and here certain herbicides can be used to advantage.

The following table lists recommended herbicides for use in shelterbelt weed control (taken, in modified form, from "Chemical Weed Control in Shelterbelts" publication 1511, 1973, Agriculture Canada).

CHEMICAL NAME	TRADE NAME	FORMULATION AND % A.I.	RATE KG/ACRE A.I.
Dichlobenil	Casoron	g (4%)	2 to 2½
Linuron	Afolan	W.P. (50%)	1 to 1½
	Lorox	W.P. (50%)	1 to 1½
Oil, Non Herbicidal	Agvil	-	9 L/acre
Paraquat	Gramoxone	E.C.	½ - 1
Simazine	Princep	W.P. (80%)	1 to 1½
	Princep	g (4%)	1 to 1½
Simazine	Amizine	W.P. (60%)	1 to 1½
Trifluralin	Treflan	E.C.	1 to 1½
Glyphosate	Roundup	E.C.	1¼ to 1 3/4

A.I. = Active Ingredient
g = Granular
W.P. = Wettable powder
E.C. = Emulsifiable concentrates

All these products should be dissolved in 150 to 200 litres of water except for gramoxone which requires twice as high a waterbase.

Under conditions where a heavy growth of weeds has already become established, application of the commonly recommended herbicides such as linuron and trifluralin is not effective. In such a case, an application of paraquat (contact killer of green plant tissue) or Roundup appear to be the only effective chemicals to use.

Herbicides are safer to use on trees growing in soils of medium and heavy texture and in soils with high organic matter content. The chemicals adhere or stick to the humus and clay particles of the soil and are, therefore, retained near the surface of the soil. In light sandy soils, the chemical may leach into the root zone and injure the trees.

Mulching

It is considered good practice, particularly for newly established plantings, to provide a protective mulch such as peat moss, straw, leaf mold, well rotted manure, or other coarse organic material over the rooting zone of newly planted trees and shrubs. Such a mulch tends to keep the soil warmer, retards rapid changes in temperatures (frost heaving) and cuts down evaporation. Weed control can be an additional result from a mulch layer.

Disadvantages of using mulch around newly planted shelterbelt trees are the increased danger of spring fires and the fact that rodents are attracted to the mulching material, especially when straw is used. Rodents such as mice often cause damage to newly planted trees by peeling off the bark of young branches. If evergreens are girdled around the base, they will die.

"Mulching" has been done recently with 1 m wide strips of polyethylene. The trees are planted in slits in the middle of the plastic strip. The polyethylene can either be transparent or black (black poly is preferred). There is no weed growth on the covered strip of soil. Keeping the plastic from being blown away appears to be a problem.

The use of fertilizer is not recommended on newly planted tree and shrub sites since the drastically cut-down root system is mainly lacking in moisture; any improvement in moisture conditions will be of much more benefit to the plants than a one shot application of fertilizer.

A protective cover, such as shingles or larger boards, is recommended for newly planted evergreens, particularly in the very windy chinook zones of southern Alberta. These protective covers shade the evergreens and give shelter from the severely drying winds. Under extreme conditions, it might be advisable to erect snowfences on the windward side of newly planted rows, both for the protection of the trees and for a snowcatch.

Early pruning

Corrective pruning, to avoid the formation of multiple stems and to repair damaged branches, is important. It is even more important when the trees are small. At this time, a little work can accomplish much by shaping the trees for the future. Otherwise, pruning is not recommended for shelterbelt trees during their early

development. The structure of the trees is meant to develop into a dense barrier of foliage (branches) which extends all the way up from ground level. Only dead and diseased wood should be removed - bottom branches should stay on the trees.

Maintainance of older plantations

Fencing

To most land users, it is quite obvious that newly planted shelterbelts should be protected from grazing, browsing or trampling by livestock. However, when the trees become established, the degree of protection sometimes decreases and livestock are allowed to enter the planting sites. Such a malpractice will cause severe damage to the trees. Cattle and horses browse the foliage from the lower limbs or even break up entire trees. Grazing within a shelterbelt will also compact the soil, resulting in less infiltration of precipitation and increased run-off. The degree of damage through browsing is directly related to the length of time the shelterbelt is exposed to the livestock. It will only take a few years for shelterbelts 10-20 years old to become completely ruined through grazing.

Because of this possible damage, it is necessary that shelterbelts be protected from animal damage by erecting a fence around shelterbelts.

Thinning and pruning

"The close tree spacings (6 by 10 feet) commonly used by public agencies during the peak period of shelterbelt planting in the 1930's resulted in tree crowding and suppression after 15-20 years of growth". This is a quote from an article written by P.E. Slabaugh (1964). A similar evaluation can be made of the shelterbelts planted on the Canadian prairies although the planting activity here did not culminate during the 1930's.

On the basis of experience and investigations, spacing recommendations for prairie conditions have changed during the last few years. In spite of the best recommendations, the public in general has a tendency to crowd the small transplants, not realizing that after a few years they will develop into large trees.

A recommended layout for a four row farmstead windbreak is shown below. Recommended spacings within the row for different species are given.

TALL HEDGE	TALL DECIDUOUS	SMALL DECIDUOUS	EVERGREEN
(fast growing)	**(fast growing)**	**(slower growing)**	**(slower growing)**
Caragana 45 cm in the row	Poplar 240-300 cm in the row	Manitoba Maple 300 cm in the row	Spruce 300-360 cm in row
OR	OR	OR	OR
Mayday 150 cm in the row	Poplar 240-300 cm in the row	Green Ash 300 cm in the row	Siberian Larch 240-300 cm in row
OR	OR	OR	OR
Honeysuckle 90-150 cm in the row	Poplar 240-300 cm in the row	Willow 150 cm in the row	Pine or 240-300 cm in row
OR	OR	OR	OR
Lilac 90-150 cm in the row	Willow 200 cm in the row	Ash mixed with Manitoba Maple 300 cm in the row	

Symptoms of an overcrowded shelterbelt that is 10 years old or older are reduced height growth, dead lower branches, thinning foliage and a reduced trunk diameter increase. Under severe crowding conditions, the trees will die at an early age, mainly from lack of moisture. Trees whose vigor has been reduced are prime targets for insect and disease attacks.

Removal of trees, usually referred to as **thinning**, is the proper management for saving overcrowded shelterbelts. Thinning will increase the growing space so that the remaining trees can obtain moisture and expand their crowns.

In multiple-row shelterbelts, thinning can be accomplished by the complete removal of one or more rows of trees or by the systematic removal of portions of the trees in one or more rows, as in the case of multiple-stem trees like the Manitoba maple and willows. The removal of entire rows is the simplest form of management and this is probably most frequently practiced. Shelterbelts are, as a rule, uniform in composition and removal of whole rows of trees has a uniform effect on the belt.

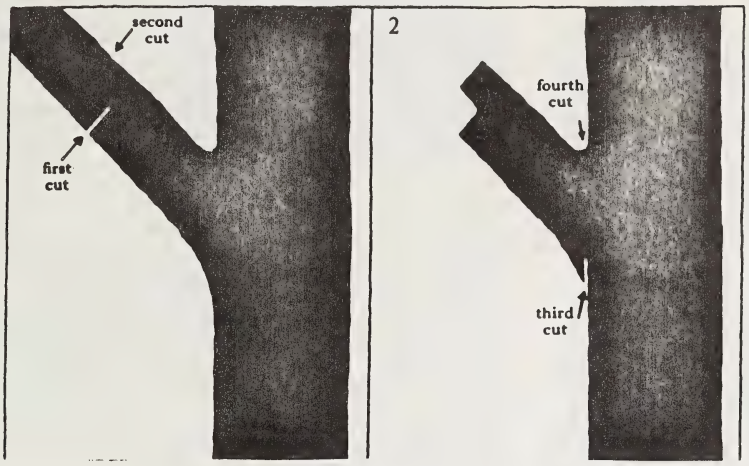
In single-row shelterbelts, the danger of overcrowding is less pronounced since the root system can utilize the fringe area on both sides of the belt. However, when spruce is planted at 1.5 - 2 m spacings, it is recommended that thinning be done by removing every second tree.

In multiple-row shelterbelts, the removal of the cut trees and slash becomes a greater chore than cutting down the trees. It is possible to follow the same principle as practised in forestry, whereby all slash and debris is left on the site. The branches are lopped off the main trunk and all debris is brought in close contact with the soil surface where moisture will cause quick decay. Of course, major parts of the tree trunks can be used for such purposes as fire wood and fence posts.

Pruning should first be concerned with the removal of dead and diseased parts of trees and shrubs. Broken or otherwise mechanically damaged trees should be repaired. This is particularly true for evergreen trees which have lost their tops. In these cases, a new leader should be selected and trained as the central stem.

Culture of a new leader of an evergreen.

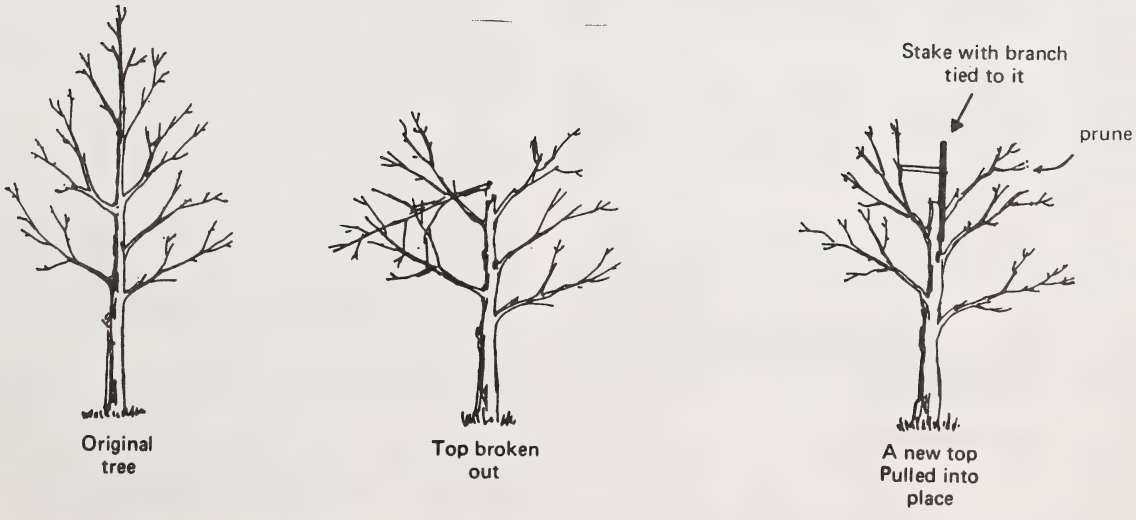
When removing broken branches, the broken part should be cut back flush with the larger stem at a lower level. Never leave stubs of broken branches. Remove the major part of the branch before making the final cut. Large wounds should be covered with a wound dressing. See diagram below.



REMOVING A LARGE LIMB

1. To remove a branch several inches thick without tearing bark and wood from the trunk, make an initial cut with a pruning saw a foot or 2 away from the trunk; saw upward into the branch until the blade binds. Then make a downward cut a few inches farther from the trunk, sawing until the limb snaps off.

2. The stub is removed without tearing bark by making a shallow cut from underneath, flush with the trunk, then sawing away the stub down from the top as close to the trunk as possible.



Repairing the broken top of a deciduous tree.

Broken tops of deciduous trees should be repaired by first removing the mutilated branches. A new branch can then be forced into the place of the leader and this branch will take over the functions of a new leader.

Pruning older shelterbelts, other than has already been discussed, should be limited to the removal of large, wide-spreading branches and to correcting the shape of the trees so that the structure develops into a well-balanced single or multiple stem. The lower branches of a shelterbelt should not be trimmed. Such pruning would open up the lower part of the belt and reduce its protective function.

Pollarding

This is a form of severely pruning older trees whereby branches of the crown are cut back to old wood. The tree reacts by producing an abundance of new sprouts which develop into branches. Newly formed branches are removed in subsequent years. Pollarding is usually practised on faster growing trees like poplar and willow. Around farmsteads, pollarding is often used to remove the tops of larger poplar trees. This is done, undoubtedly, to control the height of these trees. However, the larger cuts, which result from this form of pruning, are not usually covered with a protective dressing. Hence, the wounds do not heal-over and subsequent decay becomes a lasting injury. The physical lifespan of these trees is reduced and the natural beauty of the shelterbelt is destroyed. Unless the height of the trees has to be controlled, it is not advisable to manage poplar trees in this manner.

Tree protection from wild animals

Shelterbelt trees and shrubs can be severely damaged by animals such as rabbits, mice, porcupines, pocket gophers and deer. Rabbits are by far the most damaging small animals in central Alberta, particularly in years when their numbers reach a peak. During the winter months, the rabbits start to feed on the bark, small branches and the needles of spruce and deciduous trees.

Long-lasting commercial repellents, such a Morton Chemical's Z.I.P. or Niagara rodent repellent, are probably the most practicial form of rabbit control when a large number of trees is involved. These chemicals can be used either as a paint or as a spray.

In cases where excessive damage has been done to deciduous trees and the bark has been peeled off over larger areas, the only hope for the trees is that new shoots will develop from the base. All damaged branches should be removed. Evergreens will not develop new growth after severe damage has occurred.

Grassing of the planting site

When shelterbelt plantings grow up, the trees and shrubs will occupy larger spaces and the gaps between the trees will become smaller. This, in turn, makes it more difficult to continue mechanical weed control since farm implements can no longer be used between the trees without damaging branches. At this stage of development, it often happens that weed control is discontinued and that the previously clean, cultivated site reverts to a weed patch. Weeds, like sow thistle and Canada thistle, thrive in these places and the seeds can infest other localities.

Under these conditions, it is a good idea to seed the soil strips between the rows of trees in a multiple row shelterbelt to grass e.g., creeping red fescue. The grass cover will prevent the establishment of weeds. These strips of grass should be mowed with a small handmower. In cases where weeds have become established, it is advisable to mow them and to keep the vegetation low through mowing. This type of maintenance will considerably reduce the evaporation from the herb vegetation, leaving more moisture for the trees.

Objections to grassing have been given, since the grass groundcover will compete with the trees for available moisture. However, the use of recommended grass (creeping red fescue) and mowing is a better alternative than letting the site "go to weeds" or, worse, damaging the branches and the roots of the trees by continuing cultivation. Furthermore, the heavy shading from the trees will discourage the development of a lush, vigorous grass mat. After all, a natural forest maintains a forest floor vegetation consisting of naturally adapted herbs and mosses.

Releasing of evergreens

Evergreens, such as spruce and pine, are the most valuable species in multiple row shelterbelts. Because of their slow growth in comparison with the fast-growing varieties, such as poplar, willow and maple, these evergreens often become suppressed if they are planted too close to deciduous trees. Branches of the deciduous trees whip the tops off the evergreens and prevent them from attaining height. In general, spruce is shade tolerant and is able to hang on to life under overcrowded conditions. Pine, on the other hand, will quickly succumb to severe suppression.

Removing the deciduous trees which suppress the evergreens in a shelterbelt is a sure way of returning new life and vigor to the evergreens. Spruce and pine quickly react to the release by forming new leaders, growing new branches and foliage and increasing their diameter.

Release cutting and thinning, which was discussed earlier, are best carried out during the winter months. The deciduous trees have lost their foliage which makes cutting easier. Also, during winter there is more time to do this work. The use of a chain saw greatly aids efficiency.

Renovations of old shelterbelts

Removal of decaying poplars

Poplar trees are the fastest growing shelterbelt trees, but their lifespan is often the shortest. Their fast growth rate makes these trees a very popular species. Most farmstead shelterbelts contain one or more rows of poplar trees. Many of these farmstead plantings were established in the 1920s and 1930s and the poplar trees are now showing advanced signs of loss of vigor. In the more extreme cases, the poplars have died.

The mortality of these poplar trees is not only a result of the age of these relatively short-lived trees. Poor maintenance or outright abuse is often the main reason that poplar plantings are degenerating so fast. The malpractice of allowing cattle to graze within a shelterbelt will shorten the lifespan of these trees.

Whatever the cause for dead and dying poplar trees, a considerable number of farmsteads in central and southern Alberta have an unsightly appearance because of these rows of dead trees. The pleasing aspect of the countryside suffers from such a display and the dead trees do not serve the purpose of a windbarrier. The solution to this situation is fairly simple, since all that is necessary is to remove the dead trees. However, these trees are large and often the site is a jungle of caragana and other trees growing wild. In many cases, the farmsteads are abandoned or the farmstead, as such, is not used any longer as a residence. If the trees are cut down, the large stumps become another problem. The site cannot be worked up unless large equipment (equivalent to a D7 caterpiller) is put to work. The best approach is to remove the old shelterbelt including the stumps, and a new shelterbelt be planted in case a shelterbelt is needed. Of course, any worthwhile sections of the old shelterbelt, such as coniferous trees and elms or maples, can be retained and become part of the new layout. If the old stumps are left and the poplar trees are alive, new sprouting will develop on the old mother stumps and sucker growth from the root system will usually spring up everywhere.

Additional new plantings

As was mentioned earlier, shelterbelts containing coniferous trees are the most effective because they retain their foliage for twelve months of the year, while deciduous trees are bare for nearly seven months (average Alberta conditions). Furthermore, white spruce and lodgepole pine are species native to Alberta (where shelterbelt plantings are being established). In addition, spruce and pine are trees with a long lifespan. Once established, they can live for half a century or more, provided abuses such as grazing and fire do not interfere with the site.

For these reasons, upgrading existing shelterbelts which lack conifers by adding rows of evergreens is recommended. These new plantings should receive similar cultural care as outlined in earlier chapters of this publication. Particular attention should be given to spacing these new rows of conifers far enough away from the established belt to allow the young trees to obtain adequate moisture and light. Usually 8 m is too close to tall poplar trees because they absorb all the moisture. New plantings should be established beyond this distance.

It is a good idea to establish new planting adjacent to an existing shelterbelt where the old one becomes decadent and has just about reached its physical age limit. The new planting can grow up while the old shelterbelt still functions. When the new shelterbelt has reached a reasonable height, the old shelterbelt should be removed.

Native shelterbelts of trembling aspen can be improved through underplanting with white spruce. This is done in reforestation. Aspen stands are being converted to a mixed wood stand by planting white spruce among the trees. The spruce is shade tolerant and will slowly grow up underneath the hardwood overstory. Gradually, the poplar should be thinned out and the spruce favored.

Native shelterbelts

Native or natural shelterbelts are simply native trees left when the land is cleared. Along fencelines, adjacent to roads and around farmsteads, these windbarriers contribute greatly to the protective tree cover which is present in the agricultural zone of the province. It is of great ecological importance that this native tree cover be retained and that the land management protects these trees from such detrimental factors of grazing and ground fires.

Species composition

The native tree cover for central Alberta, located north of Edmonton, is of the boreal mixed wood forest while the aspen grove forest is found between Edmonton and Red Deer. The general area south of Red Deer is classified as the grassland zone or region. The tree cover of the aspen grove zone is, as the name indicates, mainly composed of trembling aspen with occasional birch and black poplar on the moist sites. The mixed wood forest cover consists of black and white poplar (trembling aspen), white spruce, birch and balsam fir. The remnants of this forest cover type, still found around farm fields, are largely made up of trembling aspen, while spruce and balsam fir occur only sparsely.

In an east-west direction, the higher elevations in western Alberta receive higher precipitation and here the lodgepole pine is a common forest tree species.

Protection

Trembling aspen are very intolerant of shade, sucker readily and are often infected with rot diseases. They will

maintain themselves when grown in a narrow strip such as a shelterbelt, but it is essential that livestock is kept out of the tree cover. Therefore, fences have to be maintained where livestock are kept.

Natural regeneration

Older planted shelterbelts, as well as native windbreaks should be considered as small pockets of forest stands which can maintain their existence through new growth. This is particularly true in areas where climatic and soil conditions support a forest cover under natural conditions. In older planted shelterbelts, herb vegetation, typical of the native forest stands, will re-establish itself, e.g., wintergreen, bunchberry and mosses.

Caragana may develop from seed and new plants often become a problem outside and inside older shelterbelts. Berry producing trees and shrubs such as mayday, chokecherry, dogwood, hawthorn and hedge rose will reproduce in and around shelterbelts. The natural spread of these plants is prompted by wildlife eating the fruit.

Hybrid poplars and native poplars sometimes regenerate by sucker growth or new trees can become established from sprout culture on stumps after the tree is cut down. New trees and new shelterbelts can be developed from these sprouts and suckers. If such regrowth is desired, it is advisable to cut the stumps at ground level.

Hedges from caragana, lilac, honeysuckle and dogwood can also be rejuvenated by cutting them down to ground level. New growth from the base will quickly re-establish the hedge. This form of management is particularly recommended for hedges which have become "leggy" (bare and open at the base).

Mature spruce, Manitoba maple, and Siberian elm may regenerate from seed in shelterbelts where the soil is kept cultivated. This regeneration will develop from the seedling to the sapling stage if cultivation does not destroy the seedlings. Furthermore, the shade tolerance of the species is important in the survival of these seedlings. Siberian elm does not tolerate shading, and established seedlings will not survive under an overstory. Manitoba maple seedlings tolerate shade cover to some degree and will grow slowly under a canopy of poplars. Spruce seedlings, once established, are considered shade-tolerant and can survive for many years while slowly gaining height.

In conclusion, it should be stated that only a limited knowledge has been gained as to the way planted shelterbelts will develop and regenerate over long periods of time. We know that single species of hybrid poplar shelterbelts usually die out after 50 to 75 years (or sooner, depending on environmental circumstances). It can be expected that native shelterbelts of trembling aspen will maintain their identity as a remnant of a forest cover providing abuses do not interfere with the site development. Underplanting with spruce will be an improvement. Where white spruce is used, a mixed wood forest of spruce and aspen will be established.

LITERATURE CONSULTED

1. Alberta Agriculture (pamphlet), "Planting Farm, Field, and Roadside Shelterbelts in Alberta".

2. Esau, R., Dr. R. Grover, Agriculture Canada Publication #1511, "Chemical Weed Control in Shelterbelts".

3. Alberta Agriculture (pamphlet), "Your Shelterbelt Trees".

4. Alberta Agriculture, Agdex 271/17-1, "Shelterbelt Planting and Farmstead Beautification".

5. Haliday, W.E.D., Canada Department of Resources and Development 1937, Forest Research Division, Bulletin #89, "A Forest Classification for Canada".

6. Harris, R.E. and A.C. Carder, Canada Department of Agriculture, Publication 1384, 1969, "Shelterbelts for the Peace River Region".

7. Mullin, R.E., Ontario Department of Lands and Forests, "Root Pruning of Nursery Stock".

8. Mullin, R.E., Forestry Chronicle, September 1962, Volume 38, No. 3, "Storage of Planting Stock in the Field".

9. Oosterhuis, H.T., W.C.S.H. Annual Report 1969, "What Happens to all Those Shelterbelt Trees".

10. P.F.R.A. Tree Nursery, Indian Head, Saskatchewan, T.N. Cir, 1971, "Planning Farm Shelterbelts".

11. Reid, R.A., Sixth World Forestry Congress, Madrid, Spain, 1966, "Silvercultural System for Rural Populations: Shelterbelts".

12. Ross, Norman M., Department of Interior Canada, Bulletin #1, 1931, "Tree Planting on the Prairies of Manitoba, Saskatchewan and Alberta".

13. Slabough, P.E., Proceedings of American Foresters, Denver, Colorado, 1964, "A Reappraisal of Some Silvicultural Problems of Great Plain Shelterbelts".

14. Thomson, Robert, U.S. Government Printing Offices, Washington 25, D.C., "Transplanting Trees and Other Woody Plants".

15. U.S. Department of Agriculture Handbook, 247, "Forest Planting Practice in the Central States".

16. U.S. Department of Agriculture Handbook, 250, "Tree Windbreaks for the Central Great Plains".

17. Van Haverbeke, David F., Charles E. Boldt, U.S.D.A. Forest Service, Research Paper R.M. 46, 1969, "Release Benefits Hardwoods in Crowded Shelterbelts".

18. Van Haverbeke, David F., Charles E. Boldt, Journal of Forestry, Volume 66, #3, March 1968, "Vigor and Density of Shelterbelt Conifers can be Improved".

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